MAINTAINING FIRE-ASSOCIATED BIRD SPECIES ACROSS FOREST LANDSCAPES IN THE NORTHERN ROCKIES

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INTRODUCTION

Forest fires are an important natural disturbance process in northern Rocky Mountain forests (Arno 1980, Habeck 1987). Forest fire suppression efforts in the past 70 years, however, have abated this disturbance process and consequently, created one of the potentially most ecologically detrimental human-induced changes in Rocky Mountain forests (Hejl 1994). Exclusion of fire from forests, combined with the salvage logging of the accessible acres that have burned, have prompted concern for fire-associated bird species in the northern Rocky Mountains. Fifteen bird species (woodpeckers, flycatchers and seed-eaters) are generally more abundant in early post-fire forests than in any other major cover type occurring the northern Rocky Mountains (Hutto 1995). Post-fire forests provide suitable and abundant foraging and nesting habitat for these 15 species. Studies have indicated that salvage logging decreases the suitability of post-fire forests for some bird species (Caton 1996, Hitchox 1996, Saab and Dudley 1997). Therefore, in 1997, we initiated a study to examine the effects of salvage logging of burned forests on primary and secondary cavity-nesting birds in Montana and Idaho. Of primary concern are two species, the Black-backed (a USFS sensitive species) and Three-toed Woodpeckers, which may be particularly adversely affected by salvage logging (see Table 1 for scientific names of bird species).

OBJECTIVES

To assess the effects of post-fire salvage logging on cavity-nesting birds we:

1. Compared nesting success for cavity-nesting birds in logged versus unlogged nest plots.
2. Compared habitat characteristics at nest sites and random sites.
3. Examined woodpecker foraging activities to determine preferences and characteristics of foraging habitat.

STUDY AREAS

We collected data at four independent study areas. Three of the four study areas, which are located in western Montana and were burned in 1994, have logged and unlogged portions. The fourth area, located in a wilderness area just over the border into Idaho, is unlogged and was burned in 1996. All four study areas consisted of mid-elevation coniferous forests. These forests generally experienced stand-replacement fires, however, stand perimeters and some interior patches varied in burn intensity.

METHODS

Nest Success

We systematically searched the burned areas for nests of cavity-nesting birds and Brown Creepers and Olive-sided Flycatchers. All four study sites were searched in 1997 and 1998. In 1999, only 3 sites (2 logged and 1 unlogged) were searched. By direct observation of birds at nests and the use of nest monitoring cameras, we assessed nest success and productivity. Nests were monitored every 3-4 days until the nest failed or fledged offspring.

Nest Site Selection

To quantify nest-site selection information we measured vegetation characteristics (modified BBIRD protocol, Martin et al. 1997, and complimenting Saab and Dudley 1997) within 11.3 m radius plots at nests and at systematic plots. Systematic plots were placed every 200 m along transects which covered the entire survey area at each study site. We measured vegetation at all systematic plots in 1997 and only at a third of the plots in 1998 and 1999. We tagged all trees on every third plot to examine snag longevity.

Foraging Site Selection

We opportunistically conducted foraging observations on Hairy, Three-toed, and Black-backed Woodpeckers while nest searching and monitoring. We recorded only single instances of foraging (Hejl et al. 1990). Characteristics of the foraging tree and the surrounding area were recorded for each observation.

DATA ANALYSIS

For 1997-99 data we examined selection for nesting and foraging characteristics (tree species and tree diameter size classes) by comparing the proportion of use versus the proportion available using log-likelihood ratio G-tests.

Combining 1997 and 1998 data, we calculated nesting success using the Mayfield method (1961, 1975) for species with a minimum of 10 nests in both logged and unlogged nest plots. To test for differences in nesting survival between treatments we used the program CONTRAST (Sauer and Williams 1989).

RESULTS AND DISCUSSION

Nest Site Selection

We monitored 465 nests from 1997-99 on all four study sites (Table 1). We classified nests as occurring in logged (cut stumps occurring within the 11.3 m radius nest plots) or

unlogged plots. In all years, Lewis's Woodpeckers and Williamson's Sapsuckers primarily nested in logged plots; Hairy Woodpeckers, Northern Flickers, Mountain Bluebirds and Red-breasted Nuthatches nested in both logged and unlogged; and Brown Creepers, Three-toed and Black-backed Woodpeckers primarily nested in unlogged plots (Fig. 1).

The diameter at breast height (dbh) of nest trees for nine cavity-nesting species varied greatly among species (mean dbh range = 31.1 – 71.3 cm; Fig. 2). Cavity nesters as a group selected trees for nesting that had significantly larger diameters than available trees (df = 4, $G = 439.6$, $p < 0.001$; Fig. 3).

Cavity-nesters' use of tree species for nesting differed significantly from availability (df = 5, $G = 245.83$, $p < 0.001$; Fig. 4). Forty-five percent of all nests were in Douglas-fir (*Psuedotsuga menziesii*) trees. Subalpine fir (*Abies lasiocarpa*), western larch (*Larix occidentalis*) and ponderosa pine (*Pinus ponderosa*) were used to a lesser degree (10 - 18%). Interestingly, western larch and ponderosa were used at a greater frequency than they occurred on the study areas. Lodgepole pine (*Pinus contorta*) was fairly abundant but used for nesting only 12 percent of the time.

Nesting Success

Comparison of nesting success between nests in logged nest plots and nests in unlogged nest plots was possible for four bird species (1997 and 1998 combined). Nesting success was lower in logged plots than in unlogged plots for Hairy and Three-toed Woodpeckers but the differences were not significant (Table 2). Northern Flickers and Mountain Bluebirds had similar nest success between treatments (Table 2).

For the remaining five species sample sizes were too small within treatments for statistical comparison. Overall nesting success across treatments was relatively high (Table 3).

Foraging Site Selection

We collected a total of 628 foraging observations on Hairy, Three-toed and Black-backed Woodpeckers. Ponderosa pine and western larch were used at a greater frequency than their availability (df = 5, $G = 245.83$, $p < 0.001$; Fig. 5). In contrast, Douglas-fir was the most commonly foraged on tree species, however, its use versus availability was similar (Fig. 5).

Although the three woodpecker species foraged on all trees species, they differed significantly in their use (df = 5, $G = 92.26$, $p < 0.001$; Fig. 6). Douglas-fir was most frequently used by Black-backed Woodpeckers and was used at a greater frequency in proportion to its availability (Fig. 6). Although lodgepole pine was used less than its availability by all three woodpecker species (Fig. 5), Three-toed Woodpeckers used it for foraging more than Black-backed and Hairy Woodpeckers (Fig. 6). Three-toed and Hairy

Woodpeckers each foraged on ponderosa pine about 20 percent of the time (Fig. 6), however, ponderosa pine's availability was much lower than its use (Fig. 5 and Fig. 6).

The three woodpecker species used trees similar in diameter for foraging: Hairy mean dbh = 36.7 ± 1.4, n = 207; Black-backed mean dbh = 37.3 ± 1.4, n = 174; Three-toed mean dbh = 33.9 ± 1.3, n = 247.

Larger trees were used for foraging at a greater frequency than their availability (df = 5, G = 734.00, $p < 0.001$; Fig. 7). Seventy percent of the trees used for foraging were larger than 23 cm dbh. In contrast, 78% of available trees were smaller than 24 cm dbh.

SUMMARY

Preliminary results indicate that post-fire forests, which have been salvaged logged, provide less nesting opportunities for most cavity-nesting bird species except for those that prefer open areas such as the Lewis's Woodpecker. In the logged study areas, Black-backed and Three-toed Woodpeckers, and Brown Creepers generally only were found in unlogged patches. Cavity-nesters as a group nested most frequently in Douglas-fir. The dbh of trees used for nesting varied greatly by bird species, but most trees used were larger than the trees available. Trees used for foraging by Hairy, Black-backed, and Three-toed Woodpeckers generally were larger in dbh than random trees. The use of western larch and ponderosa pine for nesting and foraging was greater than their availability on the study areas.

ACKNOWLEDGMENTS

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TABLE 1. Number of nests found for 14 bird species in four salvaged-logged and unlogged study sites in 1997 and 1998.

Species	STUDY SITES: Chamberlain (logged)		Henry Pk (logged)		Ward Mt (logged)		Warrior's Face (unlogged)		Total Nests	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
American Kestrel* (*Falco sparverius*)			3						3	-
Lewis' Woodpecker (*Melanerpes lewis*)			5	6					5	6
Williamson's Sapsucker (*Sphyrapicus thyroideus*)	1	1	2	1	2	2			5	4
Hairy Woodpecker (*Picoides villosus*)	3	4	6	7	5	4	1	13	15	28
Three-toed Woodpecker (*Picoides tridactylus*)	5	5	1	6	4	4	9	15	19	30
Black-backed Woodpecker (*Picoides arcticus*)	4	2	2	1	2	1	10	12	18	16
Northern Flicker (*Colaptes auratus*)	5	9	11	18	4	8	5	10	25	45
Olive-sided Flycatcher (*Contopus borealis*)						2		1		3
Pileated Woodpecker* (*Dryocopus pileatus*)	1	-		-		-		-	1	-
Tree Swallow* (*Tachycineta bicolor*)	1	-		-		-		-	1	-
Mountain Chickadee * (*Parus gambeli*)	1	-		-		-		-	1	-
Red-breasted Nuthatch (*Sitta canadensis*)	1			6	1	4	2	1	7	11
Brown Creeper (*Certhia americana*)	4	6	3			1	1	5	5	12
Mountain Bluebird (*Sialia currucoides*)	11	18	13	18	7	20	5	18	36	74
Total Nests	37	45	46	63	25	46	33	75	141	229

*species not monitored in 1998

TABLE 2. Percent nesting success and the number of nests in parentheses for four species in post-fire forests in 1997 and 1998. Differences in survival rates (P-value) were tested between nests in logged nest plots and nests in unlogged nest plots.

	Logged % (n)	Unlogged % (n)	P value
Hairy Woodpecker	61 (17)	94 (24)	0.12
Three-toed Woodpecker	48 (10)	87 (36)	0.11
Northern Flicker	59 (35)	49 (28)	0.52
Mountain Bluebird	46 (37)	50 (54)	0.51

TABLE 3. Overall nesting success and the number of nests for five species in post-fire forests in 1997 and 1998.

	% Nesting Success	Number of Nests
Lewis's Woodpecker	77	10
Williamson's Sapsucker	72	9
Black-backed Woodpecker	74	29
Red-breasted Nuthatch	81	17
Brown Creeper	80	16

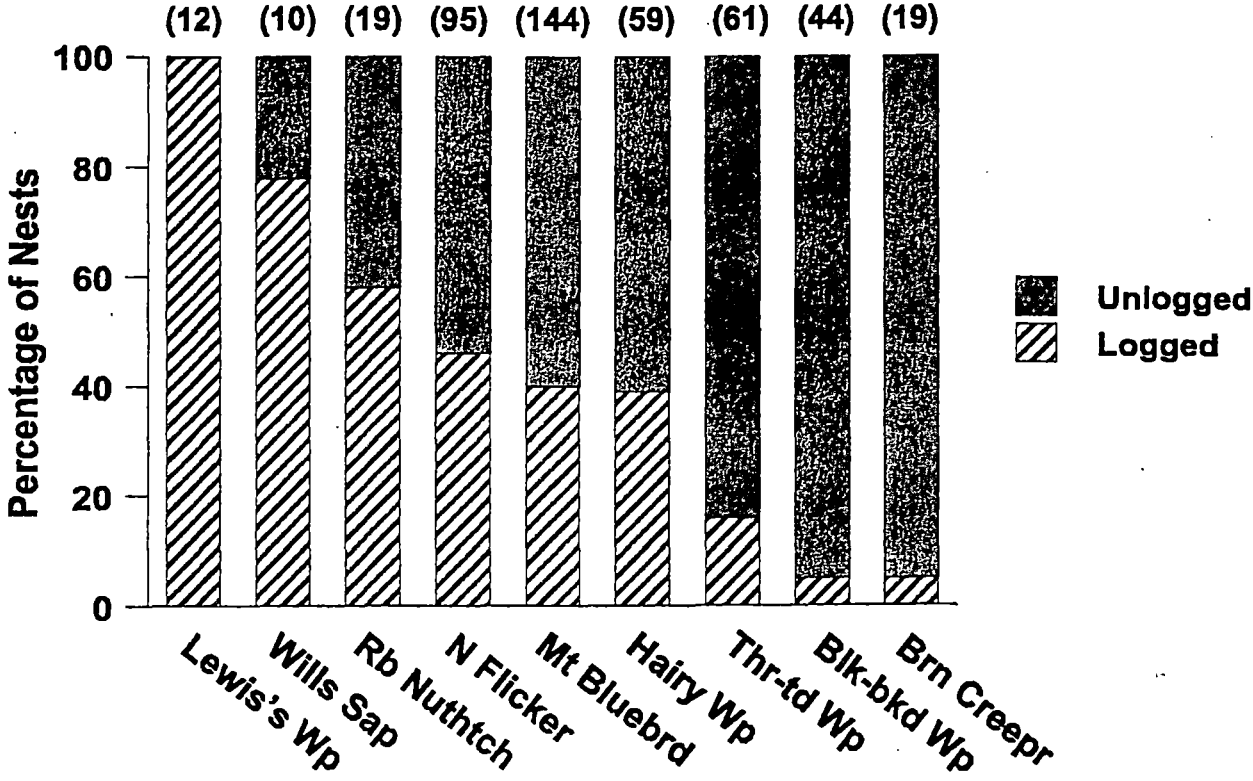

FIGURE 1. Percentage of active nests for nine cavity-nesting species in logged and unlogged nest plots. Number of nests per species listed above bar.

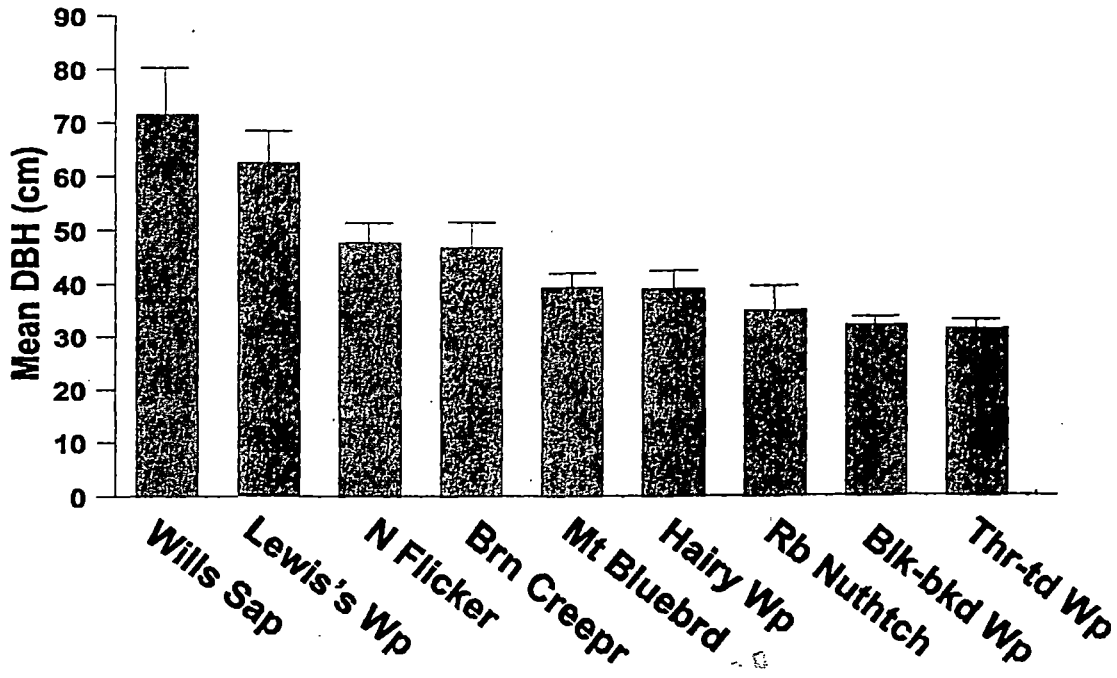

FIGURE 2. Mean dbh (+/- SE) of nest trees for nine cavity-nesting species.

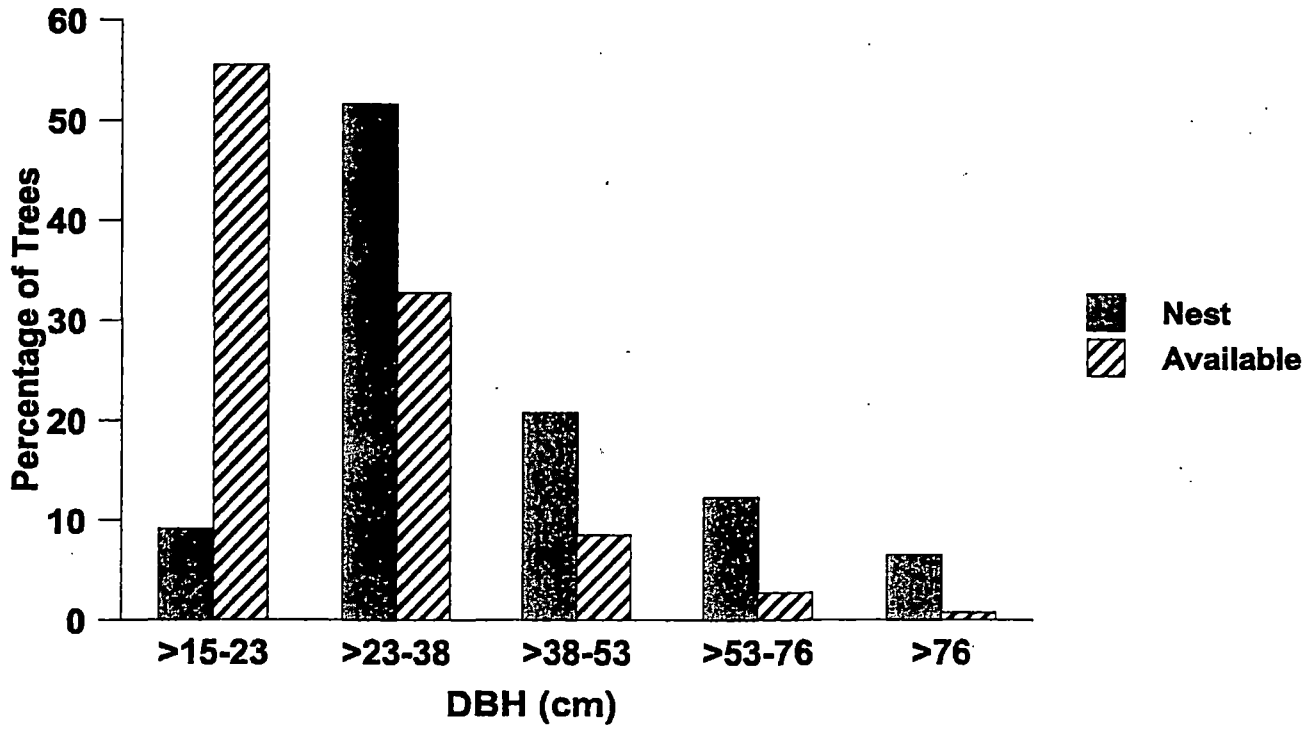

FIGURE 3. Use vs. availability of tree size classes for nesting by nine species of cavity- nesting birds.

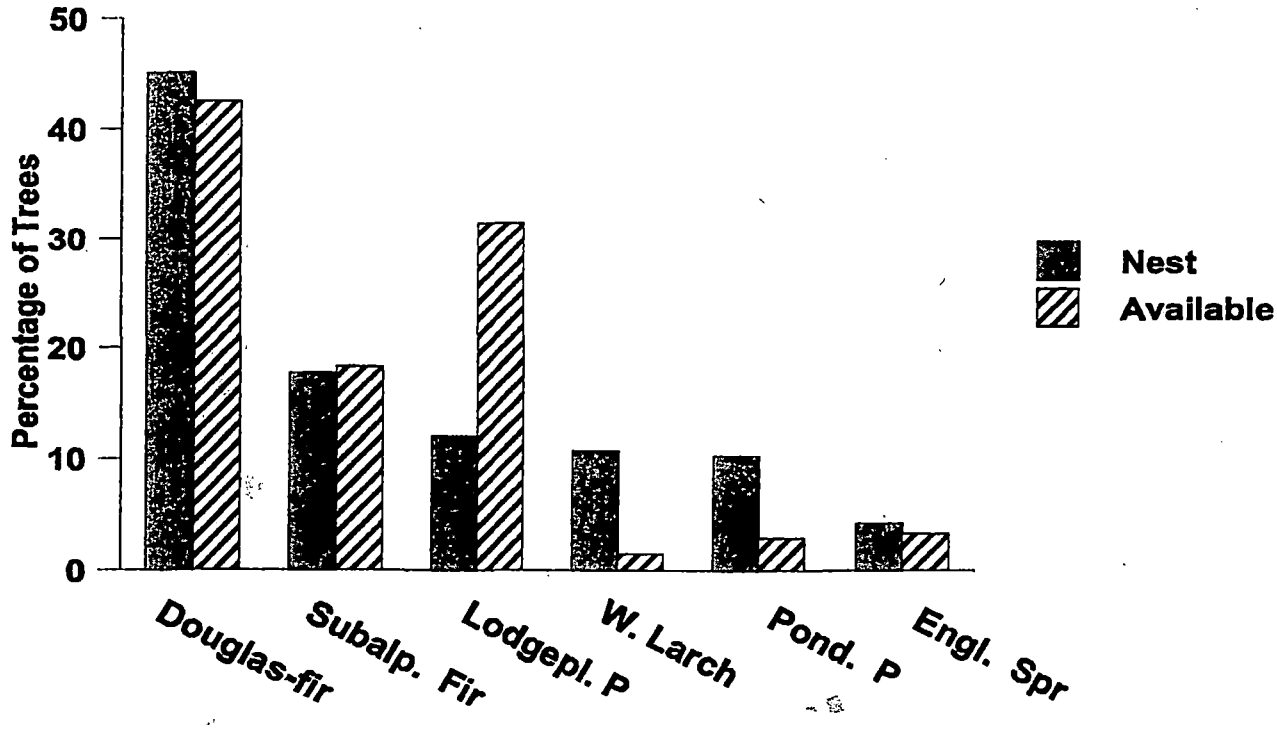

FIGURE 4. Use vs. availability of tree species for nesting by nine species of cavity-nesting birds.

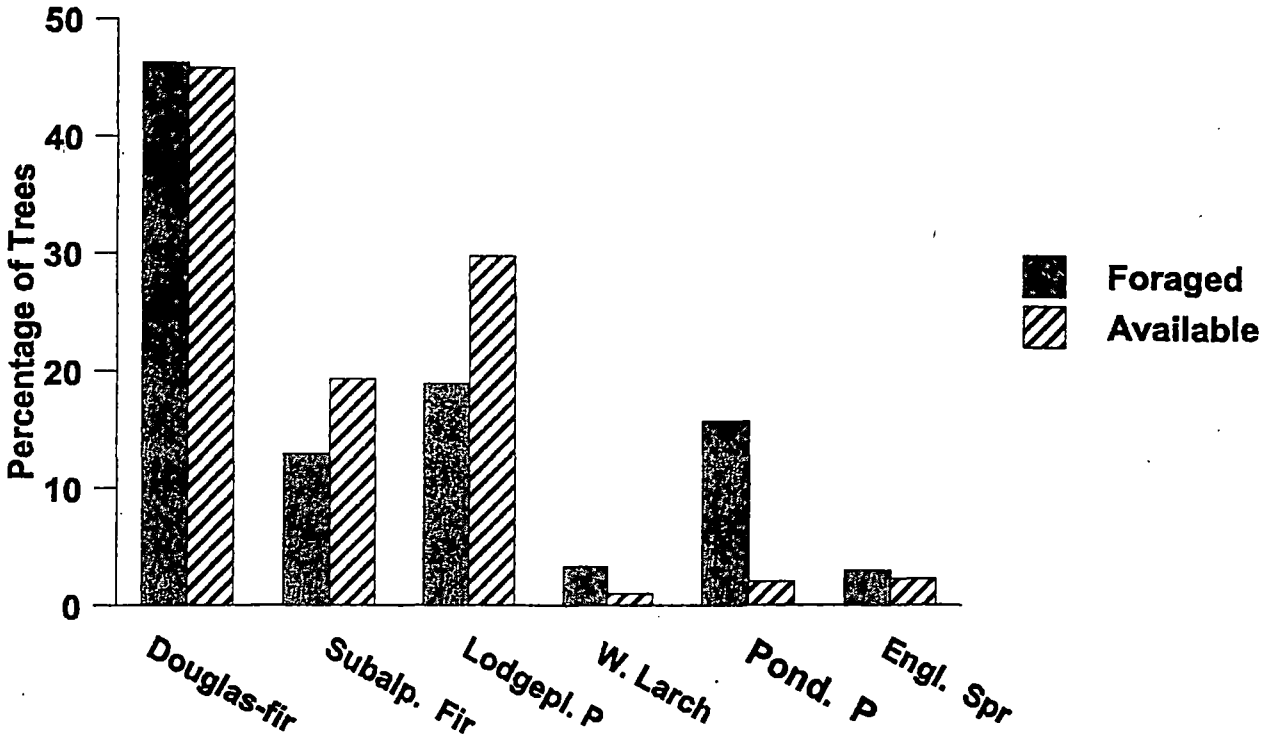

FIGURE 5. Use vs. availability of tree species for foraging by Hairy, Black-backed, and Three-toed Woodpeckers.

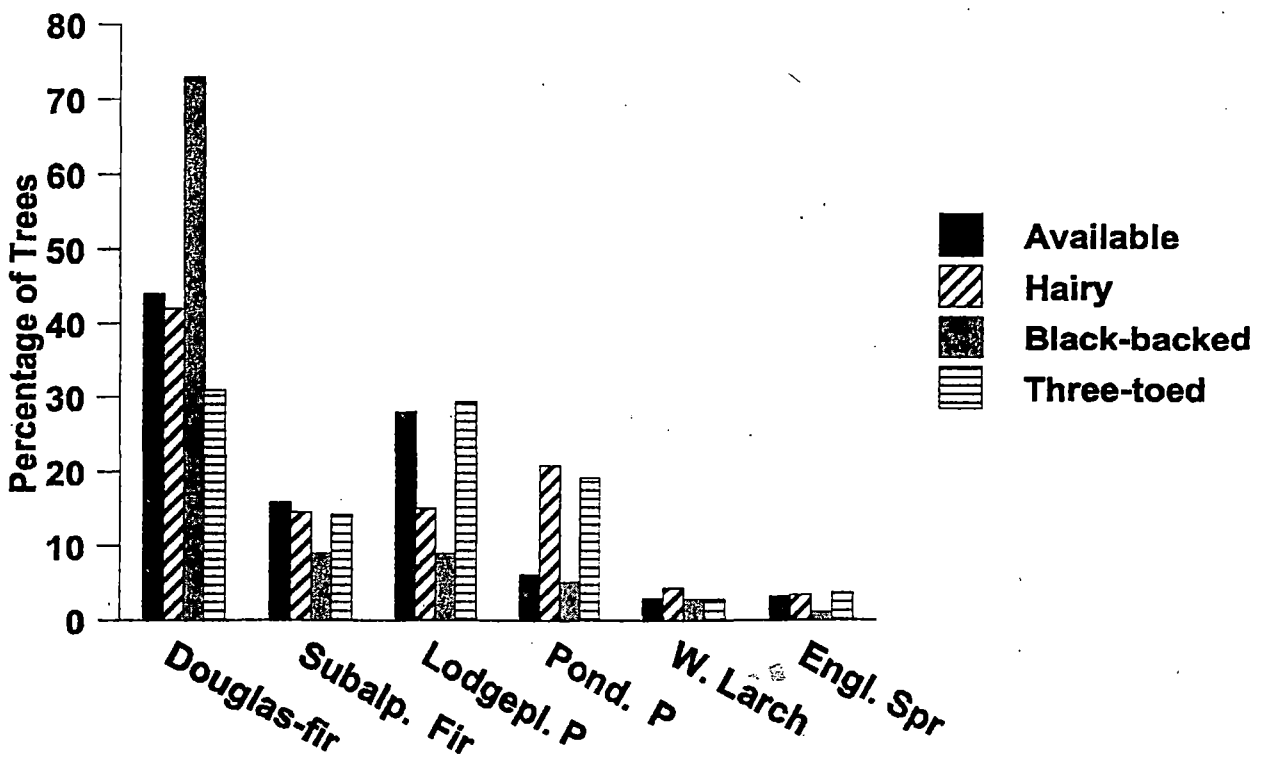

FIGURE 6. Use vs availability of tree species for foraging among three woodpecker species.

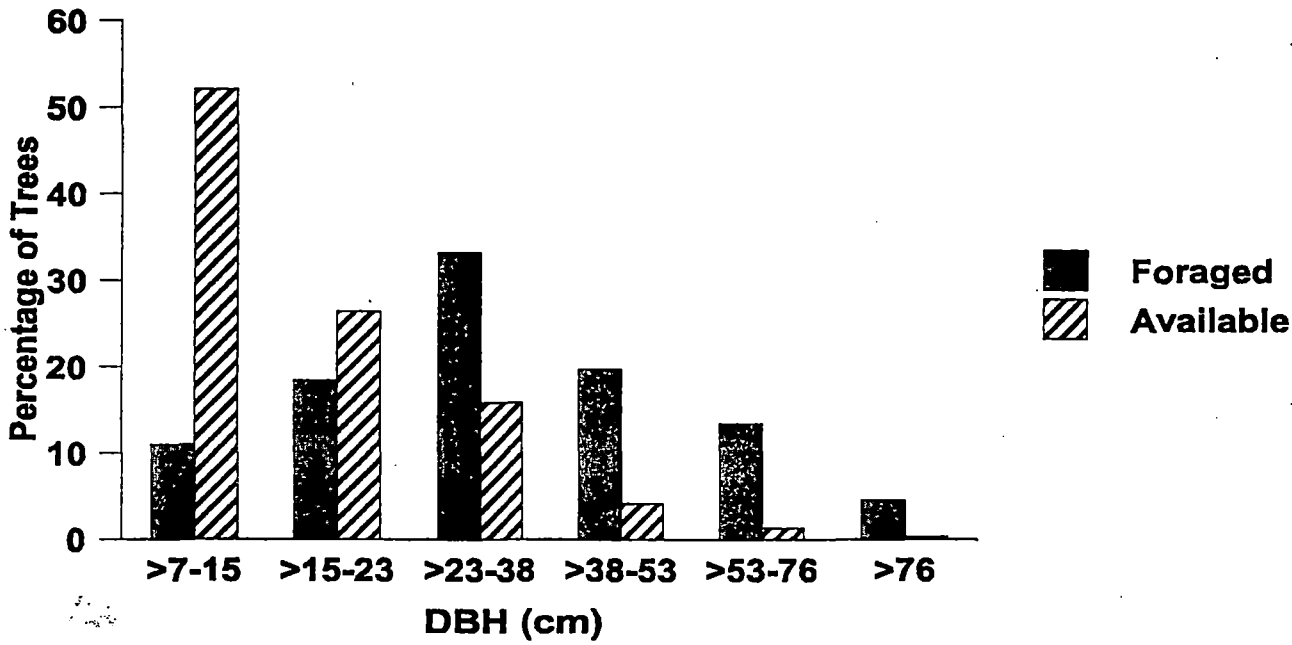

FIGURE 7. Use vs. availability of tree size classes by foraging Hairy, Black-backed, and Three-toed Woodpeckers.